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Kim

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(54) **SEMICONDUCTOR MEMORY DEVICE AND METHOD OF OPERATING THE SAME**

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G11C 16/32 (2006.01)
G11C 8/08 (2006.01)
G11C 8/10 (2006.01)

(52) **U.S. Cl.**

CPC **G11C 16/08** (2013.01); **G11C 8/08** (2013.01);
G11C 8/10 (2013.01); **G11C 16/26** (2013.01);
G11C 16/32 (2013.01)

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G11C 8/08; G11C 8/10

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365/230.06, 230.08, 63, 185.05

See application file for complete search history.

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(57) **ABSTRACT**

A semiconductor memory device includes an I/O circuit suitable for inputting and outputting data signals, and a control logic suitable for controlling the I/O circuit. The control logic includes a flip-flop suitable for operating in response to a dock signal, which is irrelevant to the data signals, and feed a first output signal back, a first pulse generation circuit suitable for generating a data output control pulse in response to a second output signal of the flip-flop which is an inverted signal of the first output signal, and a second circuit suitable for generating a strobe signal in response to the second output signal.

13 Claims, 5 Drawing Sheets

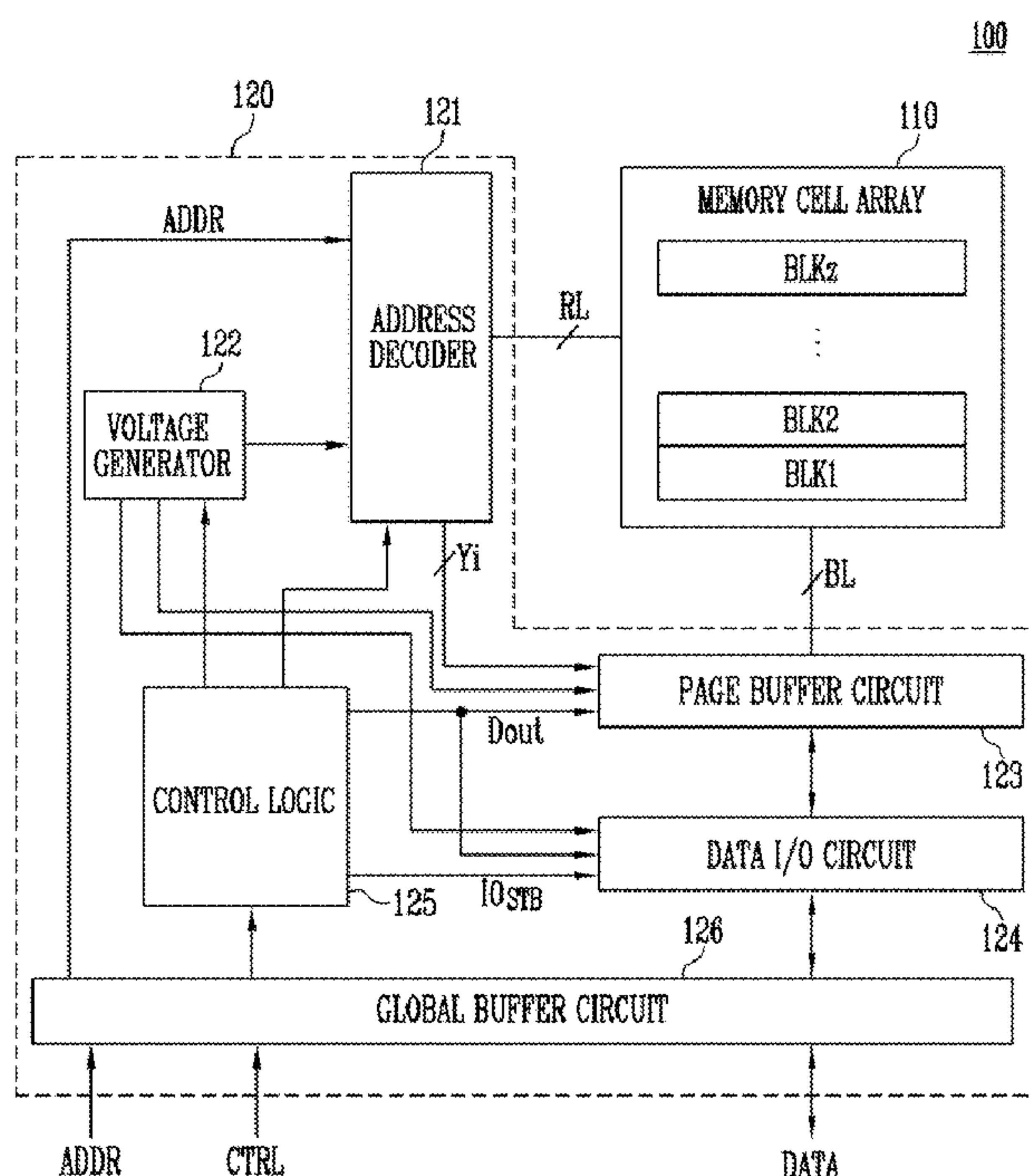


FIG. 1

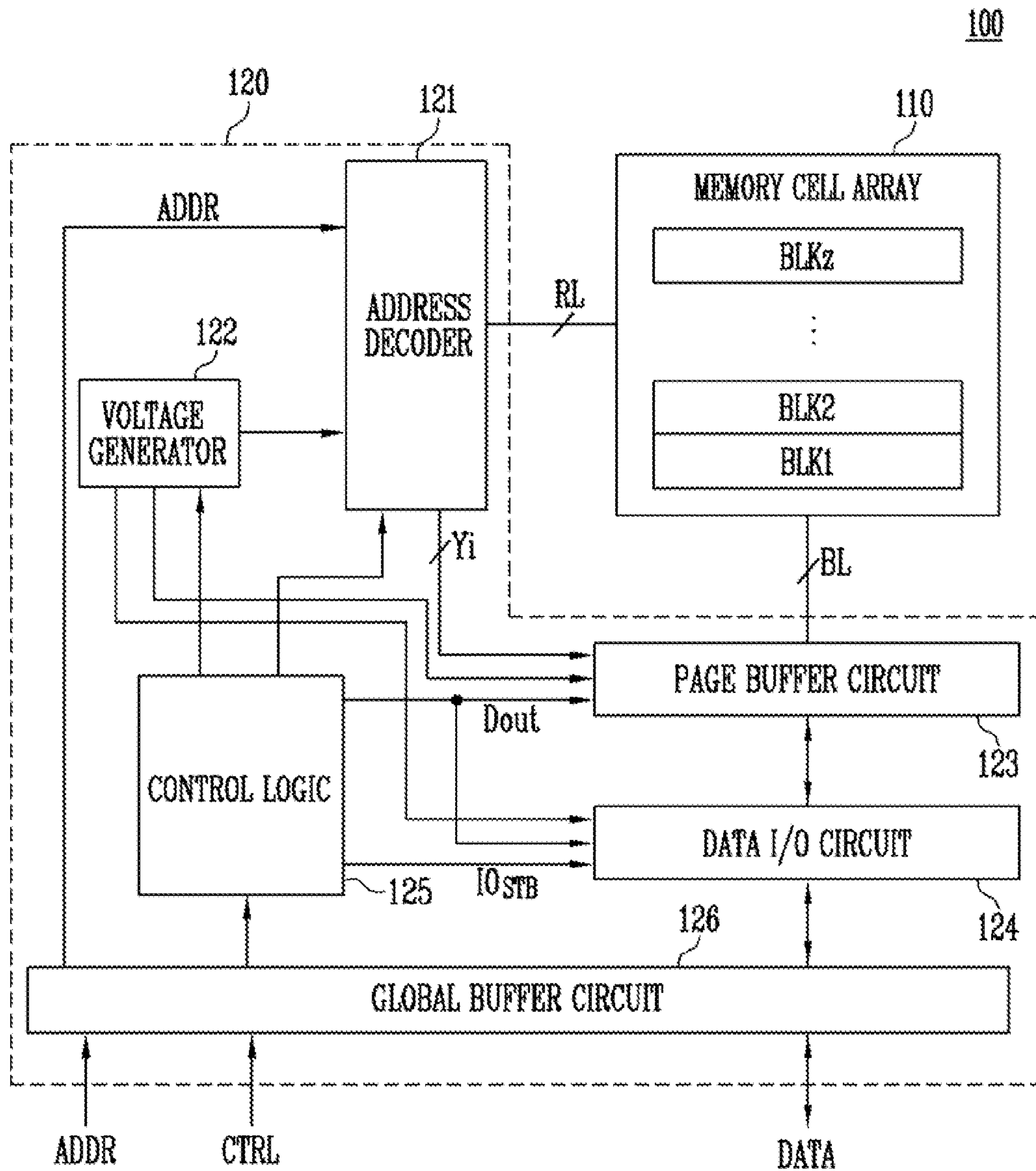


FIG. 2

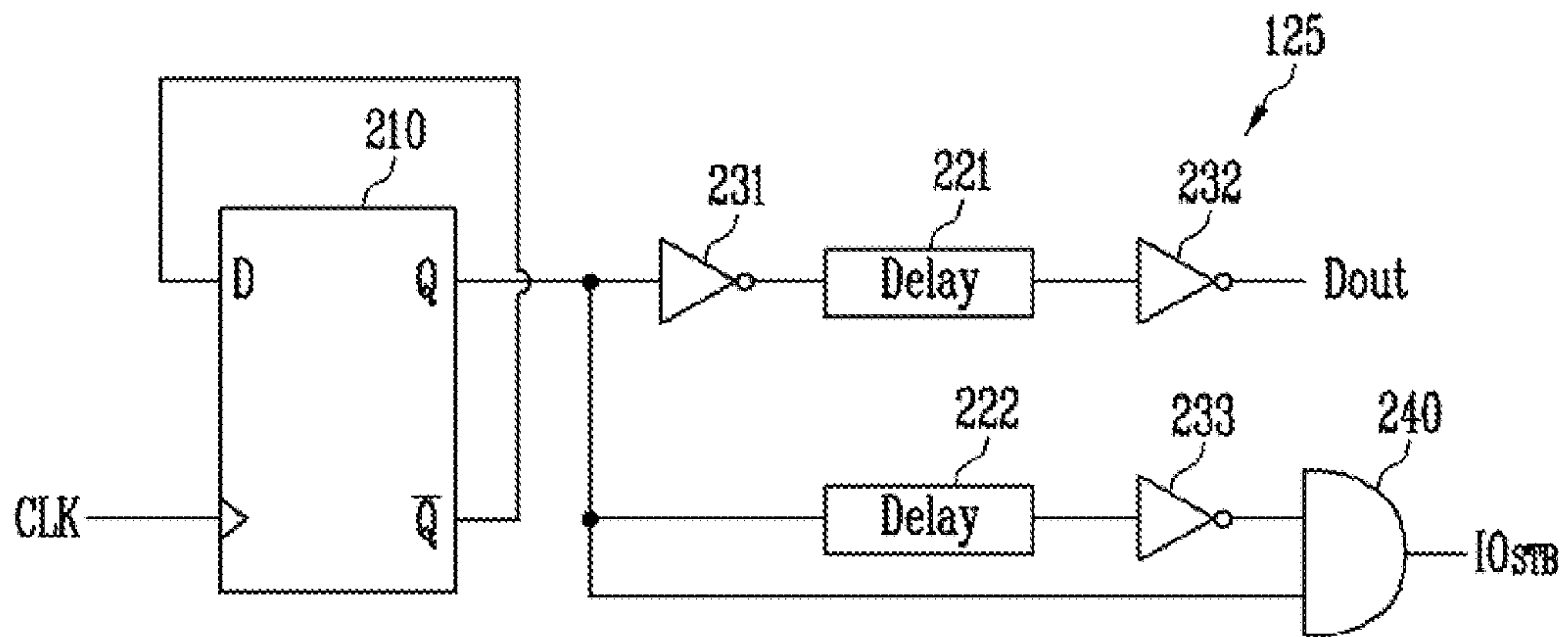


FIG. 3

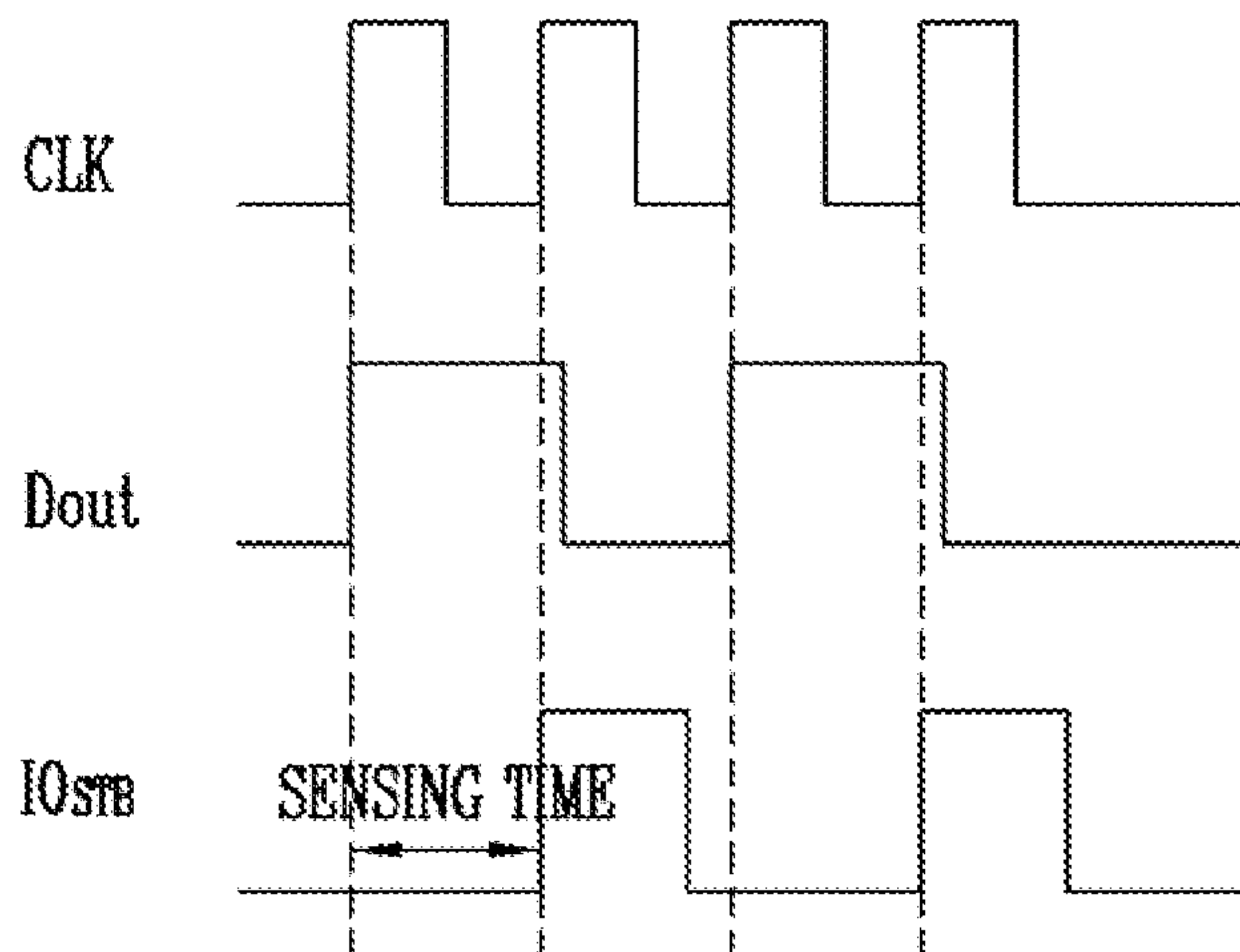


FIG. 4

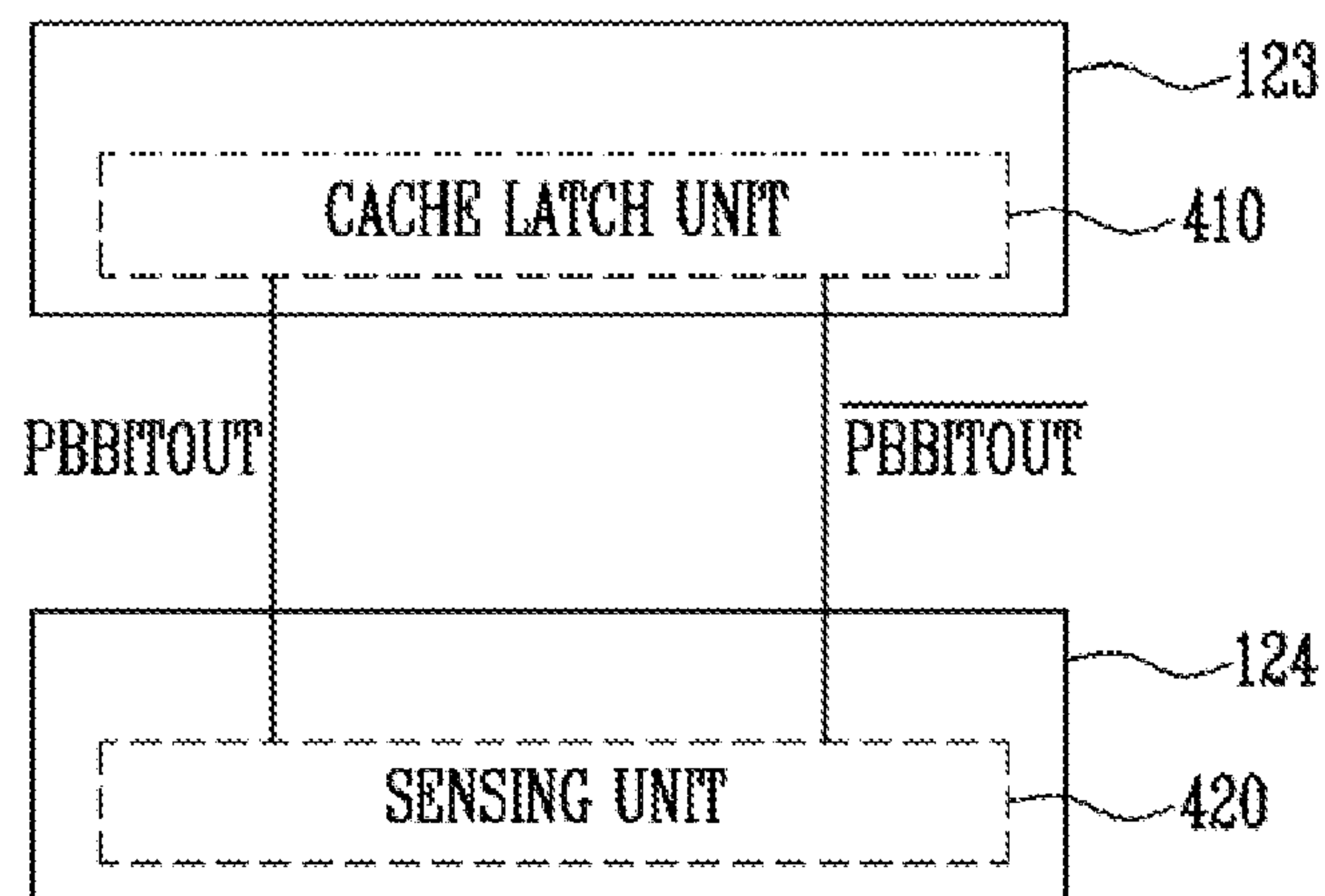


FIG. 5

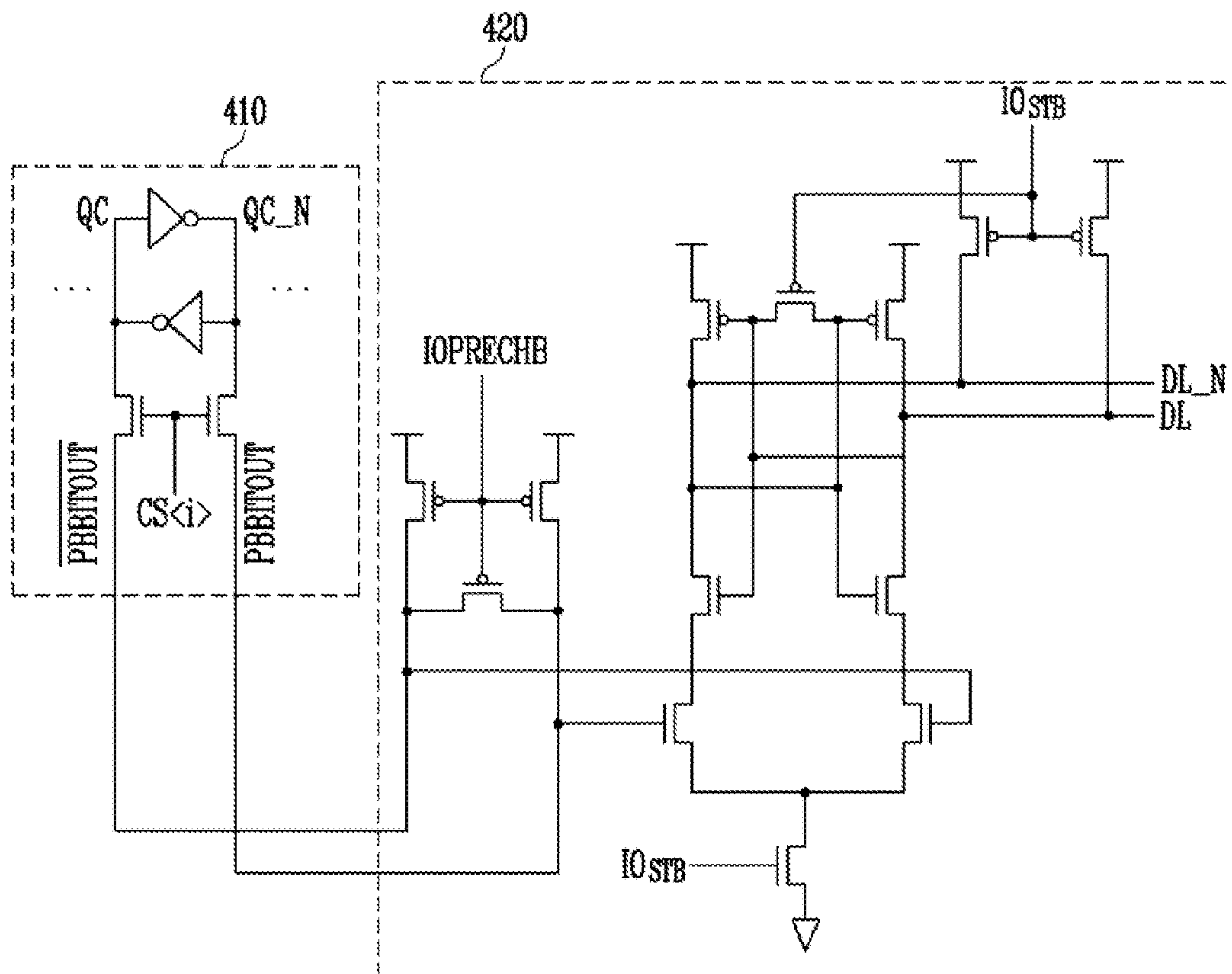


FIG. 6

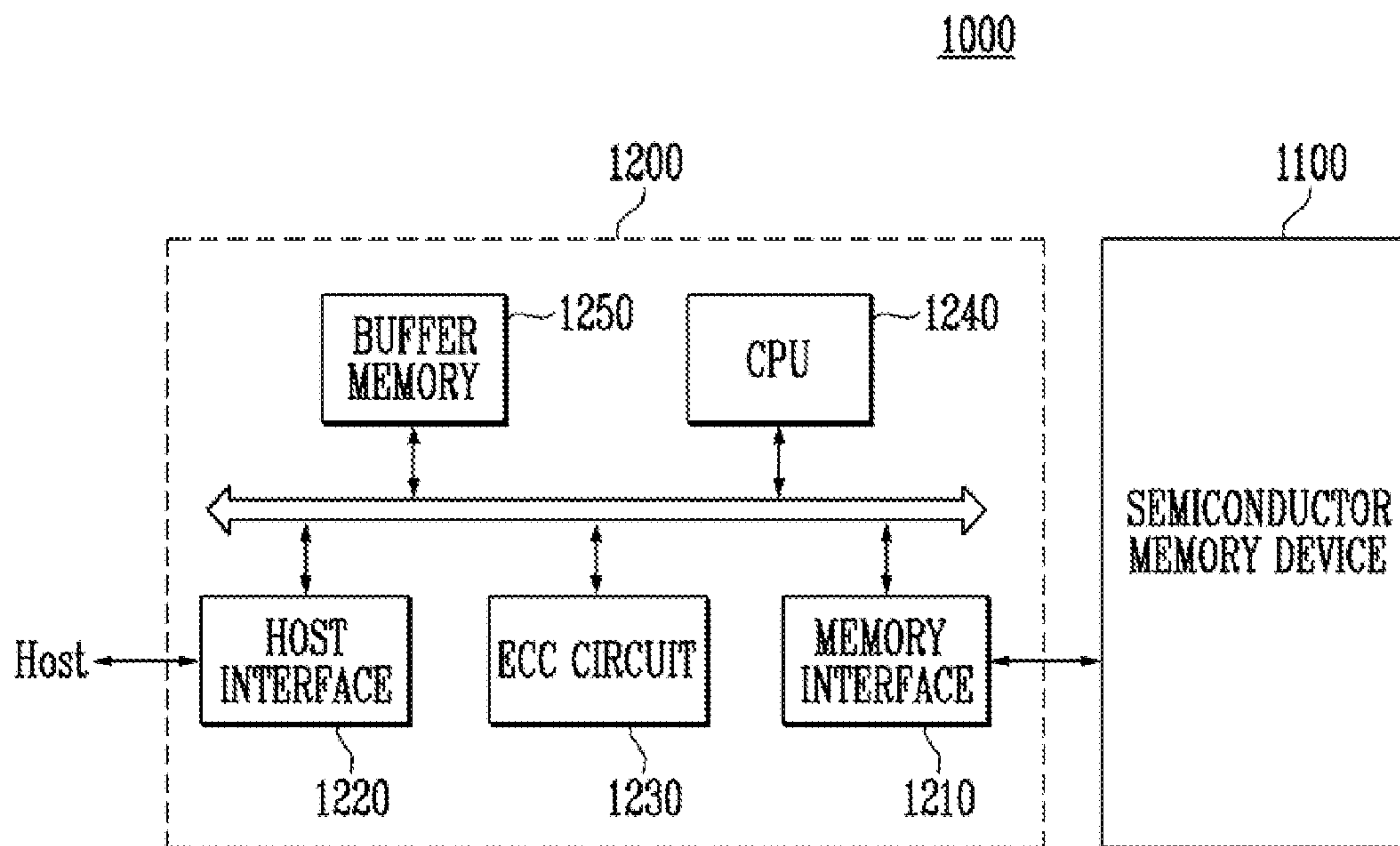


FIG. 7

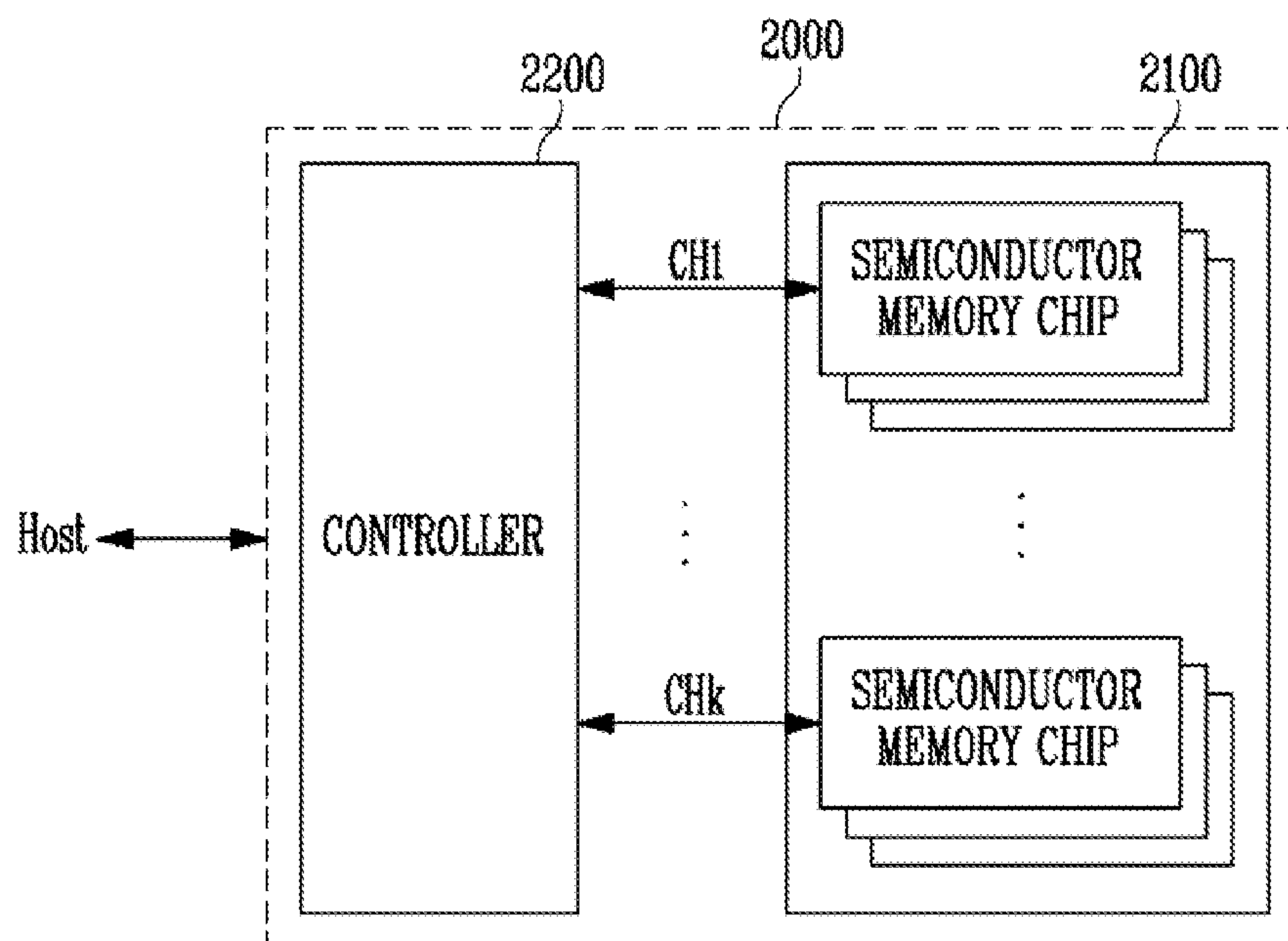
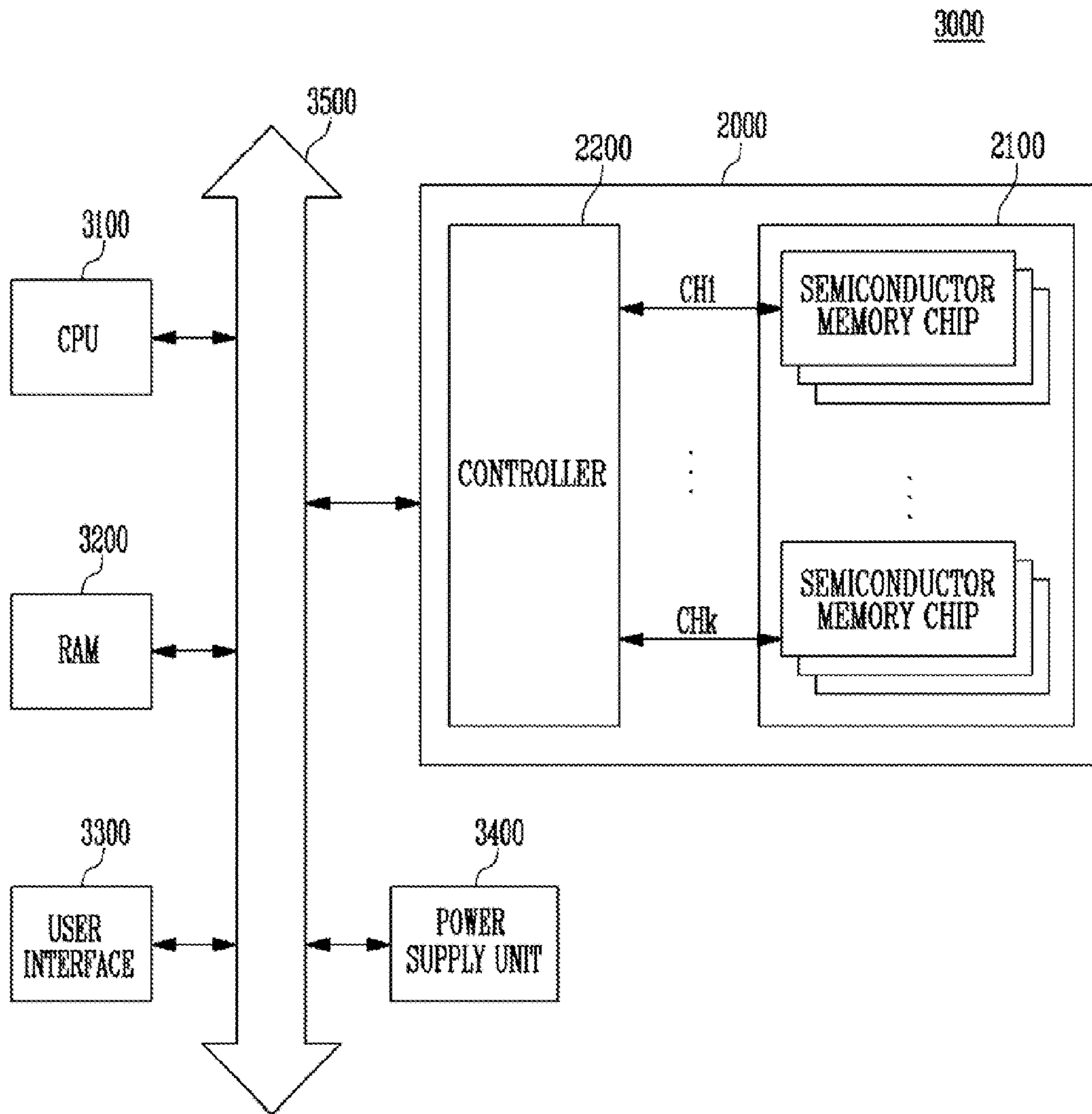


FIG. 8



SEMICONDUCTOR MEMORY DEVICE AND METHOD OF OPERATING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority of Korean patent application number 10-2013-0108573, filed on Sep. 10, 2013, the Korean intellectual Property Office, the entire disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

1. Field of Invention

Various embodiments of the present invention relate to a semiconductor design technology, and more specifically, to a semiconductor memory device and a method of operating the same.

2. Description of Related Art

Semiconductor memory devices are memory devices implemented using a semiconductor such as silicon (Si), germanium (Ge), gallium arsenide (GaAs), indium phosphide (InP), or the like. The semiconductor memory devices may be broadly classified into volatile memory devices or non-volatile memory devices.

A volatile memory device may lose stored data when a power is blocked. The volatile memory device includes a static random access memory (SRAM), a dynamic RAM (DRAM), or the like. A non-volatile memory device may retain the stored data even when not powered. The non-volatile memory device includes a read-only memory (ROM), a mask ROM (MROM), a programmable ROM (PROM), an erasable programmable ROM (EPROM), an electrically erasable programmable ROM (EEPROM), a flash memory, a phase-change RAM (PRAM), a magnetic RAM (MRAM), a resistive RAM (RRAM), a ferroelectric RAM (FRAM), and the like. Flash memories are classified into a NOR-type flash memory and a NAND-type flash memory.

Recently, the semiconductor memory device has tendencies of a high integration and a high speed operation. The semiconductor memory device has concerns in operation stability.

BRIEF SUMMARY

Various embodiments of the present invention are directed to a semiconductor memory device that may stably operate at a high speed, and a method of operating the same.

One aspect of the present invention provides a semiconductor memory device comprising: a data I/O block suitable for inputting and outputting data signals; and a control logic suitable for controlling the I/O block, wherein the control logic comprises: a flip-flop suitable for operating based on a clock signal and feeding a first output signal back; a first pulse generation circuit suitable for generating a data output control pulse based on a second output signal of the flip-flop, which is an inverted signal of the first output signal; and a second pulse generation circuit suitable for generating a strobe signal based on the second output signal.

Another aspect of the present invention provides a method of operating a semiconductor memory device comprising: generating an output signal and an inverted output signal by using a flip-flop, wherein the flip-flop receives a clock signal and feeds back the inverted output signal; generating a data output control pulse based on the output signal; and generating a strobe signal based on the output signal.

Another aspect of the present invention provides a semiconductor memory device comprising: a semiconductor memory device; and a controller suitable for controlling the semiconductor memory device, wherein the semiconductor memory device comprises: a data I/O block suitable for inputting and outputting data signals; and a control logic suitable for controlling the I/O circuit, wherein the control logic comprises: a flip-flop suitable for operating based on a clock signal, and feeding a first output signal back; a first pulse generation circuit suitable for generating a data output control pulse based on a second output signal of the flip-flop, which is an inverted signal of the first output signal; and a second pulse generation circuit suitable for generating an strobe signal based on the second output signal.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages of the present invention will become more apparent to those of ordinary skill in the art by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a block diagram illustrating a semiconductor memory device according to an exemplary embodiment of the present invention;

FIG. 2 is a detailed diagram of a control logic shown in FIG. 1;

FIG. 3 is a timing diagram for a control logic shown in FIG. 2;

FIG. 4 is a detailed diagram of a page buffer circuit and a data I/O circuit shown in FIG. 1;

FIG. 5 is a detailed diagram of a cache latch unit and a sensing unit shown in FIG. 4;

FIG. 6 is a block diagram illustrating a memory system according to an exemplary embodiment of the present invention;

FIG. 7 is a block diagram illustrating an application example of the memory system shown in FIG. 6; and

FIG. 8 is a block diagram illustrating a computing system including the memory system shown in FIG. 7.

DESCRIPTION OF EMBODIMENTS

Advantages and features of the present invention, and methods of achieving the same will be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. This invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. The embodiments of the present invention are provided for explaining in detail to be easily implemented by those of ordinary skill in the art. Throughout the disclosure, reference numerals correspond directly to the like numbered parts in the various figures and embodiments of the present invention.

Throughout the specification, it will be understood that when an element is referred to as being “connected” or “coupled” to another element, it can be directly connected or coupled to the other element or intervening elements may be present. It will be further understood that the terms “comprises,” “comprising,” “includes,” and/or “including,” when used herein, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

FIG. 1 is a block diagram illustrating a semiconductor memory device according to an embodiment of the present invention.

Referring to FIG. 1, a semiconductor memory device **100** may include a memory cell array **110** and a peripheral circuit **120**.

The memory cell array **110** includes a plurality of memory blocks BLK1 to BLKz. The plurality of memory blocks BLK1 to BLKz are connected to an address decoder **121** through row lines RL. The plurality of memory blocks BLK1 to BLKz are connected to a page buffer circuit **123** through bit lines BL. Each of the plurality of memory blocks BLK1 to BLKz includes a plurality of cell strings, and each of the plurality of cell strings includes a plurality of memory cells. As an embodiment, the plurality of memory cells may be non-volatile memory cells. In addition, each of the plurality of memory cells may be defined as a single-level cell or a multi-level cell.

The peripheral circuit **120** is configured to drive the memory cell array **110**. The peripheral circuit **120** may include the address decoder **121**, a voltage generator **122**, the page buffer circuit **123**, a data I/O circuit **124**, a control logic **125**, and a global buffer circuit **126**. In the following description, the page buffer circuit **123** and a data I/O circuit **124** are referred to as a data I/O block.

The address decoder **121** is connected to the memory cell array **110** through the row lines RL. The row lines may include drain select lines, word lines, source select lines, and a common source line. The address decoder **121** is configured to drive the row lines RL under the control of the control logic **125**. The address decoder **121** receives an address ADDR from the global buffer circuit **126**.

The address decoder **121** is configured to decode a block address among the received address ADDR. The address decoder **121** selects at least one memory block corresponding to the decoded block address.

The address decoder **121** is configured to decode a row address among the received address ADDR. The address decoder **121** is configured to apply voltages provided from the voltage generator **122** to the row lines RL corresponding to the decoded row address.

The address decoder **121** is configured to decode a column address among the received address ADDR. The address decoder **121** transfers the decoded column address Yi to the page buffer circuit **123**.

A program operation of the semiconductor memory device **100** is performed in units of pages. When the program operation is requested, the block address, the row address, and the column address may be included in the address ADDR. The address decoder **121** may select one memory block, one drain select line, and one word line based on the address ADDR, and provide the decoded column address Yi to the page buffer circuit **123**.

The address decoder **121** may include a block decoder a row decoder, a column decoder, and an address buffer.

The voltage generator **122** is configured to generate a plurality of voltages using an external voltage supplied to the semiconductor memory device **100**. The voltage generator **122** operates under the control of the control logic **125**. The voltages generated from the voltage generator **122** may be used as driving voltages of the address decoder **121**, the page buffer circuit **123**, the data I/O circuit **124**, and the control logic **125**. The voltage generator **122** may include a circuit for regulating the external voltage (or power supply voltage) and generating regulated voltages. In addition, the voltage gen-

erator **122** may include a plurality of pumping capacitors, selectively activate the plurality of pumping capacitors, and generate boosted voltages.

The page buffer circuit **123** is connected to the memory cell array **110** through the bit lines BL. The page buffer circuit **123** operates under the control of the control logic **125**.

When a data output operation is performed, the page buffer circuit **123** receives a control signal using a data output control pulse Dout from the control logic **125**, latches (or receives and stores) data DATA stored in the memory cell array **110** transferred through the bit lines BL, and outputs the latched data DATA to the global buffer circuit **126** through the data I/O circuit **124**, in order to output the data DATA through the global buffer circuit **126**. When a data input operation is performed, the page buffer circuit **123** latches (or receives and stores) data DATA input to the global buffer circuit **126** through the data I/O circuit **124**, and transfers the latched data DATA to bit lines BL selected by the decoded column address Yi among the bit lines BL. The page buffer circuit **123** may include a cache latch unit for latching data.

The data I/O circuit **124** operates for inputting and outputting data between the page buffer circuit **123** and the global buffer circuit **126**. The data I/O circuit **124** may include a sensing unit for sensing data output from the page buffer circuit **123** and transferring the sensed data to the global buffer circuit **126**.

The control logic **125** is connected to the address decoder **121**, the voltage generator **122**, the page buffer circuit **123**, the data I/O circuit **124**, and the global buffer circuit **126**. The control logic **125** receives a control signal (or a command) CTRL input through the global buffer circuit **126**. The control logic **125** is configured to control overall operations of the semiconductor memory device **100** based on the control signal CTRL.

The control logic **125** may operate additionally based on a clock signal, which is irrelevant to data signals. Further, the control logic **125** may include a flip-flop for operating based on the clock signal and feeding a first output signal back, a first pulse generation circuit for generating the data output control pulse Dout based on a second output signal (i.e., an inverted signal of the first output signal) of the flip-flop, and a second pulse generation circuit for generating a strobe signal IO_{STB} based on the second output signal of the flip-flop. In this case, the control logic **125** may activate the data output control pulse in units of $2N$ clock cycles (N is a natural number), and generate the strobe signal IO_{STB} using a falling edge of the data output control pulse Dout. In addition, the control logic **125** may control a sensing operation using the data output control pulse Dout and the strobe signal IO_{STB} , and start the sensing operation in response to a rising edge of the data output control pulse Dout and end the sensing operation in response to a rising edge of the strobe signal IO_{STB} .

The global buffer circuit **126** receives the control signal CTRL and the address ADDR from the outside, and transfers the received control signal CTRL and the address ADDR to the control logic **125** and the address decoder **121**, respectively. Further, the global buffer circuit **126** is configured to transfer data DATA from the outside to the page buffer circuit **123** through the data I/O circuit **124**, and transfer the data DATA from the page buffer circuit **123** to the outside.

FIG. 2 is a detailed diagram of the control logic **125** shown in FIG. 1.

Referring to FIG. 2, the control logic **125** may include a flip-flop **210**, delays **221** and **222**, inverters **231**, **232**, and **233**, and an AND gate **240**. The control logic **125** may control a data output operation between the page buffer circuit **123** and the data I/O circuit **124** using such a construction. In this case,

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the flip-flop **210** may be a D flip-flop. Firstly, the data output operation between the page buffer circuit **123** and the data I/O circuit **124** will be described below with reference to FIGS. **4** and **5**.

FIG. **4** is a detailed diagram of the page buffer circuit **123** and the data I/O circuit **124** shown in FIG. **1**.

Referring to FIG. **4**, the page buffer circuit **123** may include a cache latch unit **410**.

The cache latch unit **410** latches data from the memory cell array **110**, and outputs the latched data to the global buffer circuit **126** through the data I/O circuit **124** in response to the data output control pulse **Dout**. Further, the cache latch unit **410** may receive data from the global buffer circuit **126** through the data I/O circuit **124**.

The data I/O circuit **124** may include a sensing unit **420**. The sensing unit **420** senses data output to a data output line, and outputs the sensed data. When a data output operation is performed, the sensing unit **420** senses data output from the cache latch unit **410** through the data I/O line pair **PBBITOUT** and **/PBBITOUT**, and outputs the sensed data to the global buffer circuit **126**. The sensing unit **420** may be enabled in response to the strobe signal IO_{STB} received from the control logic **125**, and perform a data sensing operation on the condition in which the sensing unit **420** is enabled.

FIG. **5** is a detailed diagram of the cache latch unit **410** and the sensing unit **420** shown in FIG. **4**.

The cache latch unit **410** receives a column control signal **CS**, and transfers stored data to the sensing unit **420** through the data I/O line pair **PBBITOUT** and **/PBBITOUT**. Here, the column control signal **CS** (e.g., $CS_{<i></i>}$) may be generated by combining (e.g., ANDing) the data output control pulse **Dout** and the column address Y_i (e.g., $Y_{i<i></i>}$), and function as an output control signal for the corresponding cache latches. That is, the data output control pulse **Dout** functions as an output control signal for the cache latches, and the column address Y_i functions as a signal for designating a selected column.

The sensing unit **420** receives and senses data stored in the cache latch unit **410** through the data I/O line pair **PBBITOUT** and **/PBBITOUT**, and outputs the received and sensed data to the global buffer circuit **126**.

Referring to FIG. **4**, a precharge signal **IOPRECHB** may control to precharge the data I/O line pair **PBBITOUT** and **/PBBITOUT**. The precharge operation may be performed when the data output control pulse **Dout** is deactivated. The strobe signal IO_{STB} may end the sensing operation in response to a rising edge of the strobe signal IO_{STB} .

Referring back to FIG. **2**, the flip-flop **210** receives the clock signal **CLK**, which is not related to data signals, and generates the data output control pulse **Dout** and the strobe signal IO_{STB} based on an output signal of the flip-flop **210**. Using the flip-flop **210**, the data output control pulse **Dout** and the strobe signal IO_{STB} may be more stably generated. That is, even though a driving voltage difference between the peripheral circuit **120** and the page buffer circuit **123** is incurred depending on a surrounding environment, an influence due to the surrounding environment may be minimized and a stable data output operation may be performed. Further, since both the data output control pulse **Dout** and the strobe signal IO_{STB} are generated based on the clock signal **CLK**, and thus a stable operation may be performed.

FIG. **3** is a timing diagram for the control logic **125** shown in FIG. **2**.

Referring to FIGS. **2** and **3**, a data output signal **Dout** and a strobe signal IO_{STB} are generated using a clock signal **CLK**. As described above, the control logic **125** activates the data

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output control pulse in units of $2N$ clock cycles. For example, in FIG. **3**, one data output control pulse is activated for 2 clock cycles.

The control logic **125** may control the sensing operation using the data output control pulse **Dout** and the strobe signal IO_{STB} . Referring to FIGS. **2** and **3**, the sensing operation may start in response to a rising edge of the data output control pulse **Dout**, and end in response to a rising edge of the strobe signal IO_{STB} . At this time, a time between the rising edge of the data output control pulse **Dout** and the rising edge of the strobe signal IO_{STB} may be a sensing time. Accordingly, it can be known that the sensing time is based on the clock signal **CLK**. Since the clock signal **CLK** is a clock signal, which is not related to data signals, a stable operation may be performed regardless of the surrounding environment.

Referring back to FIG. **2**, the control logic **215** may include a delay circuit, for example, the delay **221**, for adjusting the data output control pulse **Dout**. The delay circuit may finely adjust the timing of the data output control pulse **Dout**.

FIG. **6** is a block diagram illustrating a memory system **1000** according to an embodiment of the present invention.

Referring to FIG. **6** the memory system **1000** may include a semiconductor memory device **1100** and a controller **1200**.

The semiconductor memory device **110** may have the same construction and operation as the semiconductor memory device **100** described with reference to FIG. **1**. Repetitive description will be omitted below.

The controller **1200** is connected to host and the semiconductor memory device **1100**. The controller **1200** is configured to access the semiconductor memory device **1100** in response to a request of the host. For example, the controller **1200** is configured to control read, write, erase, and background operations of the semiconductor memory device **1100**. The controller **1200** is configured to provide an interface between the semiconductor memory device **1100** and the host. The controller **1200** is configured to drive firmware for controlling the semiconductor memory device **1100**.

The controller **1200** may include a memory interface **1210**, a host interface **1220**, an error check and correction (ECC) circuit **1230**, a central processing unit (CPU) **1240**, and a buffer memory **1250**.

The memory interface **1210** transfers data output from the buffer memory **1250** to the semiconductor memory device **1100**. In addition, the memory interface **1210** transfers data read from the semiconductor memory device **1100** to the buffer memory **1250**. Here, the memory interface **1210** may use an interface manner of a NAND flash memory. That is, the controller **1200** may perform program, read, and erase operations based on the interface manner of NAND flash memory.

The host interface **1220** may include a protocol for data exchange between the host and the controller **1200**. For example, the host interface **1220** is configured to communicate with the host through at least one among various interface protocols such as a universal serial bus (USB), a multimedia card (MMC), a peripheral component interconnect (PCI), a peripheral component interconnect-express (PCI-E), an advanced technology attachment (ATA), a serial advanced technology attachment (SATA), a parallel advanced technology attachment (PATA), a small computer system interface (SCSI), an enhanced small device interface (ESDI), an integrated drive electronics (IDE), a private protocol, and so on.

The ECC circuit **1230** generates a parity bit using data transferred to the semiconductor memory device **1100**. The parity bit is stored in the semiconductor memory device **1100**. In addition, the ECC circuit **1230** detects an error of data read out from the semiconductor memory device **1100** using the

parity bit. If the detected error is within a correctable range, the ECC circuit **1230** corrects the detected error.

The CPU **1240** analyzes and processes a signal input from the host. The CPU **1240** controls the host or the semiconductor memory device **1100** through the host interface **1220** or the memory interface **1210**.

The CPU **1240** may control the semiconductor memory device **1110** based on the firmware for controlling the semiconductor memory device **1100**.

The buffer memory **1250** temporarily stores program data provided from the host or data read out from the semiconductor memory device **1100**. Further, the buffer memory **1250** may store metadata or cache data being stored in the semiconductor memory device **1100**. When a sudden power-off occurs, the metadata and the cache data stored in the buffer memory **1250** are stored to the semiconductor memory device **1100**. The buffer memory may include a DRAM, an SRAM, or the like.

The semiconductor memory device **1100** and the controller **1200** may be integrated as one semiconductor device, and may be provided as a memory card such as a personal computer memory card international association (PCMCIA), a compact flash card (CF), a smart media card (SM, SMC), a memory stick, a multi media card (MMC, RS-MMC, MMC-micro), a secure digital card (SD, miniSD, microSD, SDHC), a universal flash storage device (UFS), or the like.

The semiconductor memory device **1100** and the controller **1200** may be integrated as one semiconductor device, and configured as a solid-state drive (SSD). The SSD includes a storage device is configured to store data in the semiconductor memory. When the memory system **1000** is used as the SSD, an operating speed of the host connected to the memory system **1000** may be innovatively improved.

As another embodiment, the memory system **1000** may be provided as one among various components of an electronic device such as a computer, an ultra mobile PC (UMPC), a workstation, a netbook, a personal digital assistants (PDA), a portable computer, a web tablet, a wireless phone, a mobile phone, a smartphone, an electronic book, a portable multimedia player (PMP), a portable game player, a navigation device, a black box, a digital camera, a three-dimensional television, a digital audio recorder, a digital audio player, a digital picture recorder, a digital picture player, a digital video recorder, a digital video player, a device for transmitting and receiving information wirelessly, one among various electronic devices configuring a home network, one among various electronic devices configuring a computer network, one among various electronic devices configuring a telematics-based network, a radio frequency identification (RFID) device, one among various components configuring a computing system, or the like.

As an exemplary embodiment, the semiconductor memory device **1100** or the memory system **1000** may be packaged and mounted using a package such as a package on package (POP), a ball grid arrays (BGAs), a chip scale packages (CSPs), a plastic leaded chip carrier (PLCC), a plastic dual in-line package (PDIP), a die in waffle pack, a die in wafer form, a chip on board (COB), a ceramic dual in-line package (CERDIP), a plastic metric quad flat pack (MQFP), a thin quad flatpack (TQFP), a small outline integrated circuit (SOIC), a shrink small outline package (SSOP), a thin small outline package (TSOP), a thin quad flatpack (TQFP), a system in package (SIP), a multi chip package (MCP), a wafer-level fabricated package (WFP), a wafer-level processed stack package (WSP), or the like.

FIG. 7 is a block diagram illustrating an application example of the memory system shown in FIG. 6.

Referring to FIG. 7, a memory system **2000** includes a semiconductor memory device **2100** and a controller **2200**. The semiconductor memory device **2100** includes a plurality of semiconductor memory chips. Each of the plurality of semiconductor memory chips has the same construction and operation as the semiconductor memory device **100** described with reference to FIG. 1.

The plurality of semiconductor memory chips are divided into a plurality of groups. In FIG. 12, each of the groups communicates with the controller **2200** through first to k-th channels CH1 to CHk, respectively.

On the other hand, each of the plurality of groups may communicate with the controller **2200** through one common channel. The controller **2200** may have the same construction as the controller **1200** described with reference to FIG. 6, and control the plurality of semiconductor memory chips of the semiconductor memory device **2100** through the plurality of channels CH1 to CHk.

In FIG. 7, the plurality of semiconductor memory chips within a group are connected to one channel. However, one semiconductor memory chip may be connected to one channel.

FIG. 8 is a block diagram illustrating a computing system including the memory system shown in FIG. 7.

Referring to FIG. 8, a computing system **3000** may include a CPU **3100**, a RAM **3200**, a user interface **3300**, a power supply unit **3400**, a system bus **3500**, and the memory system **2000**.

The memory system **2000** is electrically connected to the CPU **3100**, the RAM **3200**, the user interface **3300**, and the power supply unit **3400** through the system bus **3500**. Data provided from the user interface **3300** or processed by the CPU **3100** is stored in the memory system **2000**.

In FIG. 8, the semiconductor memory device **2100** may be connected to the system bus **3500** through the controller **2200**. However, the semiconductor memory device **2100** may be directly connected to the system bus **3500**. In this case, the CPU **3100** and the RAM **3200** may perform the function of the controller **2200**.

In FIG. 8, the computing system **3000** is illustrated to include the memory system **2000** described with reference to FIG. 7. However, the memory system **2000** may be replaced by the memory system **1000** described with reference to FIG. 6. In addition, the computing system **3000** may include the memory systems **1000** and **2000** described with reference to FIGS. 6 and 7.

According to the embodiments of the present invention, the semiconductor memory device, the memory system, and the computing system may be stably operated at a high speed.

In the drawings and specification, there have been disclosed typical exemplary embodiments of the invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation. As for the scope of the invention, it is to be set forth in the following claims. Therefore, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

What is claimed is:

1. A semiconductor memory device, comprising:
 - a data I/O block suitable for inputting and outputting data signals; and
 - a control logic suitable for controlling the I/O block, wherein the control logic comprises:
 - a flip-flop suitable for operating based on a clock signal and feeding a first output signal back;

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a first pulse generation circuit suitable for generating a data output control pulse based on a second output signal of the flip-flop, which is an inverted signal of the first output signal; and

a second pulse generation circuit suitable for generating a strobe signal based on the second output signal.

2. The semiconductor memory device of claim 1, wherein the control logic activates the data output control pulse in units of $2N$ clock cycles of the clock signal (N is a natural number).

3. The semiconductor memory device of claim 1, wherein the first pulse generation circuit comprises:

a delay circuit suitable for adjusting the data output control pulse.

4. The semiconductor memory device of claim 1, wherein the control logic controls a sensing operation of the data I/O block by using the data output control pulse and the strobe signal.

5. The semiconductor memory device of claim 4, wherein the control logic starts the sensing operation in response to a rising edge of the data output control pulse, and ends the sensing operation in response to a rising edge of the strobe signal.

6. The semiconductor memory device of claim 4, wherein the clock signal is a signal that is not related to the data signals.

7. A method of operating a semiconductor memory device, comprising:

generating an output signal and an inverted output signal by using a flip-flop, wherein the flip-flop receives a clock signal and feeds back the inverted output signal;

generating a data output control pulse based on the output signal; and

generating a strobe signal based on the output signal.

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8. The method of claim 7, wherein the generating of the data output control pulse is activated in units of $2N$ clock cycles of the clock signal (N is a natural number).

9. The method of claim 7, further comprising outputting data signals based on the data output control pulse and the strobe signal.

10. The method of claim 7, wherein the generating of the data output control pulse comprises:

adjusting a delay of the data output control pulse.

11. The method of claim 7, wherein the clock signal is a signal that is not related to the data signals.

12. The method of claim 9, wherein the outputting of the data signals comprises:

performing a sensing operation, wherein the sensing operation starts in response to a rising edge of the data output control pulse, and ends in response to a rising edge of the strobe signal.

13. A memory system, comprising:

a semiconductor memory device; and

a controller suitable for controlling the semiconductor memory device,

wherein the semiconductor memory device comprises:

a data I/O block suitable for inputting and outputting data signals; and

a control logic suitable for controlling the I/O circuit,

wherein the control logic comprises:

flip-flop suitable for operating based on a clock signal, and feeding a first output signal back;

a first pulse generation circuit suitable for generating a data output control pulse based on a second output signal of the flip-flop, which is an inverted signal of the first output signal; and

a second pulse generation circuit suitable for generating a strobe signal based on the second output signal.

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